Diagnostic Evaluation and Remediation For Effective Learning

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DIAGNOSTIC EVALUATION AND REMEDIATION FOR EFFECTIVE LEARNING

1.0 Introduction

The problem of wastage and stagnation is well known at the primary stage. The failure and ultimate dropout is no less then 35% to 40% and sometimes this figure rises upto 60%. It can be attributed to a number of factors especially the economic and social pressures and social needs. Nevertheless, educational factor does play a significant role. An unmotivated child, unmotivated teacher, the unconducive supervision, irrelevance of the curriculum, unmeaningful learning material, uninteresting teaching and onslaughts of the promotional examinations are all significant features that contribute to the magnitude of the problem of stagnation and wastage. To deal with this problem multipronged approach is needed. To limit our discussion to the evaluation component of the teaching - learning process I like to make the following assertion :

IF THE EDUCATION OF AN ELEMENTARY TEACHER PROVIDES HIM WITH THE KNOWLEDGE AND SKILL TO USE EVALUATION FOR DIAGNOSING PUPILS' LEARNING DIFFICULTIES AND THE RELATED CAUSES HE CAN MINIMISE STAGNATION AND WASTAGE BY ADOPTING SUITABLE REMEDIAL MEASURES TO MAXIMISE THEIR LEARNING.

It may perhaps be appropriate to define first the terms 'evaluation and effective learning' so that techniques of diagnosis and remediation could be discussed accordingly.

2.0 Evaluation Defined

The term, evaluation is no longer used now for examination or measurement of educational outcomes. It is now increasingly realised that evaluation is a process which is concerned ultimately with making decisions. Such decisions may be about the process of learning, testing, administration or effectiveness of an end-product. For this sound judgements are pre-requisite. Unless valid judgements are not available, right decisions cannot be taken. Judgement forming rests on a particular methodology, basis or referent that one prefers to use. A judgement formed with reference to an objective or the individual himself.

Thus a judgement is the outcome of a certain mode of interpretation of data. Collection of information is, therefore, the starting point for evaluation. Threading together the four aspects we may now define evaluation as a process of collecting information about pupils' learning and processing it to form judgements which in turn are used to take decisions about men, materials and methodology of teaching-learning process.

From the above definition we can delineate the following components of evaluation.

a. Information gathering
b. Information processing
c. Judgement forming
d. Decision making

Effective Learning

What is effective learning and how to use evaluation for effective learning, are two questions. Effective learning constitutes the development of understanding, skills and abilities that are considered relevant and appropriate for the learners as intended in the courses of studies or curriculum prescriptions. However, it is expected that each pupil must attain a certain minimum level of mastery so that he can benefit maximally for his further learning. In other words, say at the primary stage, learning level on Unit - 1 should be such that he can learn best on Unit - 2 which in turn must be learnt or mastered to the extent that maximum learning on Unit - 3 is possible.

Effective learning is conditioned by aptitude, quality of instruction, perseverance, time allowed for learning and ability to benefit from instruction (Carrol,1963). Ability to benefit from instruction pre-supposes a minimum pre-requisite entry behaviour and appropriate motivation on the part of the learner, of course, assuming the needed quality of instruction. If pre-requisite entry behaviours are lacking, a learner will not be able to benefit from instruction and cannot reach the intended level of learning. It is, therefore, imperative that pupils' difficulties and weaknesses may be diagnosed at every entry point of learning episodes so that appropriate remedial measures may be taken to make up the deficiencies and bring up the learner to the needed level on the learning continuum. Such entry behaviours are not limited to cognitive area but are more significant with reference to affective behaviours, and even psychomotor abilities. We may now try to define, "Effective learning as the mastery of those concepts and processes which enable a learner to derive the maximum benefit from instruction and learning episodes provided to achieve the intended learning outcomes of a learning units in a gives time."

From this definition the following components of effective learning may be identified.

a. Desired motivation/affective behaviour
b. Needed pre-requisite skills/concepts.
c. Time allowed for learning
d. Quality of instruction
e. Ability to benefit from instruction

From the point of view of diagnosis all these requisites are of great significance.

Diagnostic Evaluation :

Although every evaluation is diagnostic in one form or the other the evaluation which is aimed at discovering or uncovering pupils' weaknesses is called diagnostic evaluation. It can be of two types, the educational and non-educational diagnosis. Teacher is mainly concerned with the educational causes though non-educational causes also do affect the educational endeavour of the child. Non-educational causes could be organic or environmental. Educational diagnosis aims at improving the achievement of the learner by :

a) proper placement of the learner in the learning sequence.
b) hastening the process of learning.
c) increasing the efficiency of instructional process.
d) reinforcing and feedback of learning outcomes.

Thus any evaluation that provides evidence which can be used for ensuring any of the above processes is diagnostic evaluation. Of the immediate aspects which are relevant to such of the above four functions are as follows :

* a.1 Identifying pre-requisite entry behaviours

a.2 Use of readiness test, or using evidence from analysis of performance on the previous unit test.

a.3 Provide remedial measure if needed, .to bring the learner upto the minimum presequiste level.

b.1 Locate the inadequacies and gaps on learning.

b.2 Identify the causes of poor performance.

b.3 Provide more time for re-learning or reteaching.

c.1 Identify the poor performers.

c.2 Determine the causes of under-achievement.

c.3 Classify the underachievers in terms of their needs.

c.4 Provide alternative strategies for individual, group or class instruction.

d.1 Report back results of evaluation regularly and immediately after testing.

d.2 Inform and appreciate pupils' adequacies in learning.

d.3 acquaint the learner with inadequacies in learning.

d.4 Plan for diagnosing the cause of inadequacies in learning.

d.5 Provide suitable corrective to bring the underachievers to the optimum level.

Preventive and Curative Diagnosis

Like medical diagnosis the proventive diagnosis aims at taking such measures or steps which prevent occurence or reoccurence of weaknesses, difficulties or problems that retard or hinder learning by the child. Comparing a low achiever with the high achiever for ranking purpose in a report card is nothing but to develop a sense of incompetence in the low achiever which altimately may develop into a negative self-concept leading him to further deterioration. This can be prevented by developing a reporting system in which which the referent may be self or rate of progress of the in individual himself rather than the class. Likewise many types of situations like poor vision, emotional disturbances and other environmental factors if diagnosed at appropriate times can prevent later problems in learning.

Curative diagnosis aims at discovering the causes of the problems in learning and providing remedial action to cure the ills. Non-educational causes, need more thorough probe in which apart from teachers other people like the learner's peers or community members have to be involved. As for educational causes, the teacher can himself deal with such situations.

Steps in Diagnosis

6.1 Identifying pupils with learning difficulties

It is not very difficult to identify pupils who need help and further coaching before they could benefit properly from instruction. His constant interaction with students provides good opportunities to observe them in different situations and identify poor performers. The following sources may be tapped to identify such students.

a. Teacher8s own observations in class room

[illegible]
instruction

b. Achievement records or students.

c. Students' own view of themselves.

d. Parents' opinion about their wards.

6.2 Locating pupils' difficulties

Although diagnostic evaluation is continuous process which accompanies every teaching-learning episode a planned and deliberate effort can be made in the beginning of every session before commencement of developmental teaching. The problem is easier where unit-wise teaching and testing is in vogue. Since most of the schools still have annual promotion system, class based diagnosis is useful.

The following techniques may be tried for this :

a. Previous achievement :

The usual annual tests yield scores on different subjects which indicate their level of achievement. Those achieving less than 75% marks may be classified into three major categories say; category A with 60-74 marks; B with 45 to 59 and C below 45 marks. Students with 75 marks and above may either be given some additional enrichment material or be asked to help students of category B while category-A students would work independently for improving their learning. In the meanwhile remedial work with group-C is undertaken by the teacher. After a few days when this Group-C comes upto the level of Group-B combined remedial teaching can be done. Likewise when this group (B+C) is given remediation this brings up most of the students to the desired optimum level of achievement. This may take even one month, but this is worthwhile because it saves time during developmental teaching and prevents staggering of students right at the start of the session. Moreover, cumulative effect of indequacies is prevented among low achievers.

Class Work :

Assessment of class work through oral questions provides feedback to teachers to judge the effectivemess of his own, teaching besides ascertaining the gaps if any, in the learning of student. It is here that specific difficulties of particular students can be remedied during the instructional process itself. Difficulties relating to listening, comprehension expression, communication etc., can be identified through oral questioning and teaching, if needed, is adapted to remedy the diagnosed problems.

c. Home Assignments

If teacher is aware of the purpose of different types of assignments he can give assignments, according to the needs of the students. Students poor in drawing skills need not have the same assignments as those whose handwriting needs improvement. This can be based on the appraisal of the home assignments. Even when some assignment are given and assessed it does indicate specific types of weaknesses and strengths of students that hinder or promote their learning. This becames the basis for remedial action. Depending upon the purpose of assignment, analysis of students' responses or products of learning can be done to diagnose the inadequacies in learning and provide the remedial measures thereafter.

d. Behavioural manifestations

Students' behaviours inside or outside the class reflect their interests, attitudes, habits and values. A student who is generally bullying aggressive, non-cooperative, intellectually dishonest, hates manual work, untidy, or does not mix up with his peers and shows such other manifestations, provides relevant information which needs further diagnosis, teachers' own observation supplemented with other sources like information from family or peers, does provide diagnostic clue for remediation.

e. Teachers' Observations

Since teacher is closely watching the pupils throughout the school hours it is possible for him to identify the unerachievers the unadmusted, the truant and the slow learners. A regular record of specific but significant incidents or events with regard to such pupils may be kept in teacher's diary. Such a record helps the teacher to compile evidences which later on forms the basis for determing the causes of maladjustments. In fact a vigilant-teacher can easily identify the pupils who ned help, encouragement or treatment.

f. Opinions of others

Opinion of parents, other teachers, his class-fellows and all those who see him grow and educated. Parents are best evaluators for reflecting on lecting on the health habits and study habits of of their children. Peers are good judge for reflecting on social interaction. Therefore, diagnosis of effective behaviour is better done outside the class. Such opinions help the teacher to make his estimation.

9. Case study of the individual/interview

In extreme cases where some unusual and serious problems affecting child's growth have arisen case study technique may be used. A comprehensive longitudinal record of history of such students can be traced to find out the untoward experiences or incidents which might have had some bearing on the learning of such students. No doubt this is not an easy job but this is to be used in such cases which are rare. In other cases simple interview technique may be used in which face to face conversation with the pupil is arranged and attempt is made to identify the cause.

6.3 Use of Diagnostic Tests

By and large teachers are more concerned with diagnosing learning difficulties in the area of scholastic achievement. When simple analysis of previous achievement as indicated in the performance on unit tests, is done, it becomes clear as to where do the learning gaps exist. Such concepts with students have not been able to master are termed as hard spots in learning. It is these hard spots which need further investigation so that specific cause of errors of students may be known and the remedial action could be taken. A diagnostic test is an achievement test in miniature.

Like an achievement test it measures pupils' achievement but its scope is narrowed down to a very limited content restricted mainly to the fundamental concepts and skills or the hard spots in learning. Its focus is on finding out the weaknesses in students' learning so that some remedial action could be taken. The steps as delineated below would indicate the difference in its construction.

a. Pinpoint the content area to be worked out for diagnosis. Analysis of previous unit result or teachers' own observation can be the deciding factor. This may be a complete unit, a module or a few concepts. Depending upon that one or a battery of diagnostic tests may be developed.

b. Analyse the content of the unit/module/topic and develop a possible sequence in its organisation.

c. Delineate the content into various learning or teaching points, each point being a significant intended outcome.

d. Arrange each learning point in order of hierarchy or complexity of the concepts or skills involved.

e. Write test items on each of these learning points testing students ability to understand the basic or fundamental concepts and skills.

f. Replicate each item thrice so that it facilitates in drawing inferences later on during analysis.

g. Organise the items into sets of 10 to 20 items each, thereby making each test of 30 items to 60 items.

h. Prepare instructions for each test of the battery and allot time.

6.4 Analysis and interpratation of date

a. Administer the test, score the scripts and tabulate scores in sequential order of the learning points.

b. Analyse the scores by means of student-item chart (annexure - A) which depicts individual scores on each item of the test arranged in ascending or descending order. This chart provides inspectional measures of the strengths and weaknesses of students.

c. In accordance with the students' performance as indicated by analysis of student item chart, students may be categorised as under :

i) Those who show poor performance on the lower level item say, (out of 30 items in 10 sets of 3 items each) on items 1 to 9 i.e. in sets 1-3.

ii) Those who show poor performance on sets 4-5 (item 12-21)

iii) Those who show poor performance on set 8-10 (item 24 to 30).

Generally it would be seen that those students who are poor on item 1-9 will also be poor on rest of the items. Likewise, those who are poor on items 12-21 will also be poor on item 24-30. Depending upon the input resources one can increase the number of groups for remedial work later on.

7.0 REMEDIATION :

Remediation is a process of providing correctives to make up for gaps in learning of students so as to bring them up to a level on a learning continuum, till he masters the fundamental or pre-requisite knowledge for skills and is able to get the maximum benefit of instruction. Therefore, remediation involves :

a. taking cognizance of under achievers.

b. understanding of gaps in their learning.

c. classification of under-achievers into convenient groups on the basis of learning gaps.

d. selection of relevant correctives.

e. appraising the effect of remedial work for mastery of fundamentals.

f. using alternative remedial techniques if needed, for some students.

Once the causes are known remediation will not be a problem. Difficulty arises when low achievement is due to certain causes which require long ranged treatment. Retardation in basic skills, inadequate work study skills scholastic aptitude factors, organic defects, emotional factors like attitudes, interests etc. are the usual factors associated with poor performance. When detailed analysis is done, may be with the help of teacher counsellor, then the data can be summarised for different individuals. Such a report may include besides the identification data, interview data pupils' physical conditions, educational records, mental test data, home conditions etc. This type of detailed analysis is needed only in extreme cases or problem children which inspite of repeated measures are not able to improve.

Ultimate purpose of diagnosis is to provide basis for effective remedial measures. Results of diagnosis have significance only if remedial measures and corrective instruction are possible. Whenever causes are common to a number of students group remediation may be planned. Backwardness may be general, common to all subjects or it may be specific if subjectwise. Accordingly, class group or individual measures may be adopted.

Now comes the instructional correctives. Unless diagnostic information is translated into specific learning or instructional correctives all efforts are useless and a sheer waste of time. No one corrective can be prescribed to all the individuals even having the same causes of poor performance. However a variety of correctives listed below can be tried by. teachers to see for themselves the effectiveness of each.

8.0 Instructional Correctives

Since unit teaching is assumed to be the normal practice in our instructional 'programme, the development of unit correctives is the last step in achieving intended objectives of the unit. A corrective is a supplementary approach for teaching the unit. However, best a teacher m be there will be 25 to 30% of students who will fail to lea some materials. To help such students to get through this material some alternative have to be found out to capitalis on the time and effort a teacher has to put in. Corrective is the answer. The basic principle of a corrective for a learning unit is to learning unit is to

a. teach the same material as planned in the unit

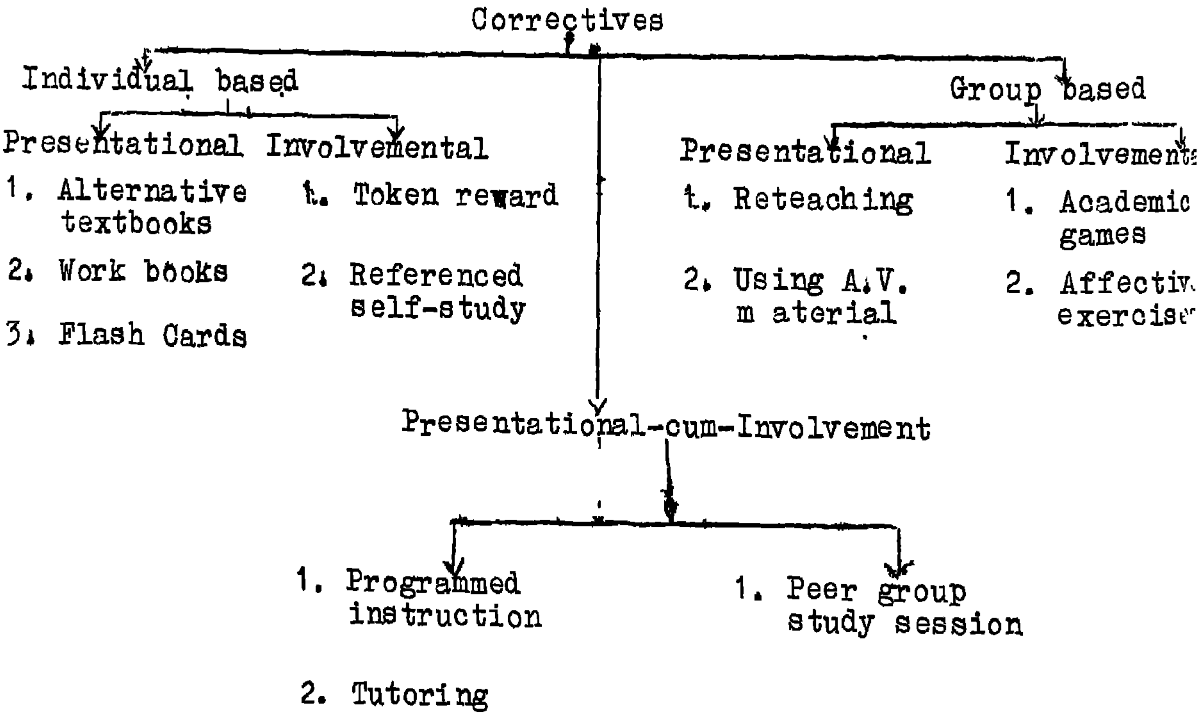
b. teach in a manner different from the planned unit.

c. supplement the group based instruction.

d. provide alternative to the group based plan.

By and large the unit material is to be presented again, of course, in a different manner. Likewise students have to be involved in learning, of course, in a way different from the group based plan.

Correctives can be used for an individual or a group of students. Accordingly, individual based or group based correctives can be used. Following types of correctives ca be identified keeping in view the above two criteria.



Each of the above types of correctives can be understood better for the effective use by the following illustrative table.

	Type of Correctives	Change in methodology of teaching/learning.
1.	Alternative textbook Individual-Presentational	Alternative treatment of content elements from the prescribed textbook.
2.	Work book	More familiarity with content elements of thettextbook by referring to corresponding pages in workbook.
3.	Flash Card Individual-involvement	Giving points in exchange for learning which can be converted into meterial reward or preferred activities.
4.	Token rewards Individual-involvement	Giving points in exchange for learning which can be converted into material rewards or preferred activities.
5.	Referenced self-study Individual-involvement	Suggesting pinpointed learning material and resources to be consulted and studied.
6.	Reteaching Group-Presentational	Reteaching with different methodology, illustrations and style or getting the difficult material retaug by a different teacher.
7.	Using Audio-Visual Material Group-Presentational	A.V. aids if not used earlier, use of different or additional or teacher made A.V. aids if not used earlier.
8.	Academic games Group-Involvemental	Involving students with similar learning problems in modified existin games for solving problems mined goal

9.	Affective exercises Group-Involvemental	Students with similar learning problems are made to experience problematic material at an emotional level e.g.
10.	Programmed instruction Individual-presentational/Involvemental	Referring to relevent pages in a programmed text for continuous positive reinforcement for their learning of material.
11.	Tutoring Individual-presentational/Involvemental	Presenting problematic materials in various ways and involving students in different ways depending upon learning difficulties can involve bright classmates former students or adults for tutoring weak students.
12.	Peer group study session Group-presentational/Involvemental	Discussing by 3 to 4 students having different learning problems thereby tutoring each other and being tutore at the same time.

The above mentioned correctives are only suggestive. Many more variations can be devised and tried out. There is some evidence to indicate that individual correctives are more effective with older students than younger ones. Similarly the involvement correctives seems to be more effective than presentational ones.

9. Choosing a Corrective

All the correctives suggested above cannot be applied in all the situations. Much depends on the type of difficulties, resources, time and teacher's ingenuity to apply a corrective effectively.

Besides these corstraints, the important conditioner is the group-based instructional plan used by the teacher. Sinceremedial work envisaged alternative strategy to supplement instruction already undertaken we should first look to the instrucvional plan (Unit plan) used by the teacher in developmental teaching and know the following :

a. Mode of development of concepts
b. Type of sense modalities used.
c. Types of mental abilities tapped.
d. Mode of students involvement.
e. Mode of evaluation applied.

To explain each of these aspects, the first one refers to sequential organisation of concepts and taking care of the principle of readiness, motivation, reinforcement and transfer for developing those concepts. The gaps or omission in sequential development of concepts becomes the basis for providing remediation. Likewise, we may identify whether auditiary (lectures, explanation, discussion,) visual (readingfilm, chalk-board work, graphics) or tactile (making models, painting, experimenting) mode of sense modalities is used. Mostly the teachers emphasise most on the first mode, less on the second mode and least on the third mode. The corrective has to be selected keeping in view the mode less emphasised.

As for primary mental abilities, instructional pla can be analysed to see the emphasis on verbal comprehensio word fluency, numerical ability, spatial ability and short term memory ability. Depending upon the nature and scope of a lesson or unit plan of instruction different emphasis can be given to the relevant mental abilities in the memedi programme.

To judge students involvement one may look for intrinsic (internal) and extrinsic (external) incentives provided in the instructional plan. Intrinsic incentives may be in the form of using a) Students' prior learning, b) their interests c) novel situations, d) challending problems e) clear or ambiguous) etc. Idea is to see as to what extent the instructional plan stimulates and excites the learner to explore and pique their curosity to learn more. As for extrinsic (external) incentives those may be in the for, of material incentives (praise-grade-Money), social incentives (teacher' praise, public recognition, peer praise) or learners preferred activities (free time, time of hobby - use of library, leading a game).

To appraise the evaluation mode check the instructional plan for adequacy, variety and quality of questions used as a teaching device (during instruction) and for review of lesson for knowing the attainment of intended learning outcomes.

A list of analysis of the above mentioned components can be developed noting the conceptual organisation, modalities, abilities, incentives and evaluation mode that your plan seem to neglect. Accordingly, develop your corrective which takes care of the neglected concepts, modalities, abilities, incentives and evaluation aspects.

10. Monitoring the corrective phase

The first task is to key each corrective to the unit (diagnostic) test on the basis of which low achievers or remedial clientale were identified. It is better to use only objective type or very short answer question in such a test. Moreover, provision for double entry of responses or ticks be made on the answer sheet so that one could be given to the student and one remains for record with the teacher. For keying purpose a "Correction Sheet" may be developed which contains the numbring of items on the test, the objective tested by each item and the corresponding correctives from which the student can choose for restudy, review or reuse, the relevant one. It is assumed that during test construction an additional stick of 3" x 5" index card items is kept for use afterthe correctives are applied. To judge the effectiveness of remedial work, the 'back-up items relevant to items missed on the unit (diagnostic) test are used. Record students' performance on each back-up item indicating the number of item and encircling it if the student attempted it correctly e.g. ②means item number - 2 being attempted correctly. If the students' performance on back-up items is satisfactory praise him privately then and there and publically in the classroom on the outset of the next session. "Satisfactory learning is satisfactory learning and it must be recognised as such, regardless of when it is attained" (Block and Anderson, 1975).

11.0 To Sum up

For any instructional impact to improve students' learning diagnostic evaluation has to be an integral part in the teaching learning process. Major purpose is to diagnose the weakness, inadequacies and gaps in learning and then locate the coresponding causes for each. When learning inadequacies are general for the whole class then class correctives have to be applied. When individual or groups have different inadequacies in learning the corrective have to be selected accordingly. When causes are non-educational other therepeutic measures have to be adopted. Besides accurate diagnosis and application of related corrective, the equally important thing is the timing of each diagnostic effort and its immediate remediation before the next instructional unit. The more work we do for diagnosis and remediation in the first term of the session the less and less will be the input needed in the forth-coming terms.

The amount of time and energies spent on diagnostic and remedial phases in terms of total instructional effort and time may sometimes not be in commensurate with expected return in term of class but it is definitely going to favour weaker section of students in a class, towards improvement of their learning.

ONE HOUR SPENT ON DIAGNOSIS AND REMEDIATION
SAVES FOUR HOURS TO BE SPENT LATER, ON
DEVELOPMENTAL TEACHING.

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M.S.

ANNEXURES

ANNEXURE - A : STUDENT ITEM CHART

ANNEXURE - B : SAMPLE DIAGNOSTIC TEST

ANNEXURE - C : REFERENCES

ANNEXURE - A

25-A

STUDENT ITEM CHART

Learning Points (L.P.)	L.P. (1)	L.P. (2)	L.P. (3)	L.P. (4)	L.P. (5)	L.P. (6)	L.P. (7)	L.P. (8)	L.P. (9)	L.P. (10)	L.P. (11)	L.P. (12)	Total
Items → / Students	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	31-33	34-36	No. correct
A	✓	✓	✓	✓	✓	x	x	x	x	x	x	x	15
B	✓	✓	✓	✓	✓	x	x	x	x	x	x	x	15
C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	x	30
D	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	x	30
E	✓	✓	✓	✓	✓	✓	✓	x	x	x	x	x	21
F	✓	✓	✓	✓	✓	✓	✓	x	x	x	x	x	21
G	✓	✓	✓	✓	✓	✓	✓	x	x	x	x	x	21
H	x	x	x	x	x	x	x	x	x	x	x	x	00
I	x	x	x	x	x	x	x	x	x	x	x	x	00
Total	7	7	7	7	7	5	5	2	2	2	x	x	

Subject: Biology Class- VI-VIII
Unit :- Seeds No. of Test-I
Area of difficulty: Structure of Maize Grain

DIAGNOSTIC TEST

Instructions to the Teachers

1. This test is not meant to measure achievement of the pupils in the area of the topic. This test is to be administred only to those pupils who show signs of either misinformation or misconception about the topic "Structure of the Maize Grain".
2. The purpose of administration of this test is to locate the specific difficulties of individual pupils. Location of the difficult learning points helps the teacher to modify his teaching method so as to cover these points more thoroughly and effectively in future, and to help the backward student to clear the point of difficulty.
3. No alternative is to be provided in the test. The pupil is to attempt all questions.
4. Three questions on each learning point are included.
5. The student will carefully read each question and with the answer to each question against the number of the question provided in the right hand margin of the question paper.
6. As far as possible sequence of learning points may be maintained while arranging the items of the test.

Contd...2 -

7. There is no fixed limit of time in which to complete the answers. These 36 questions should not take more than 46 minutes. A maximum of 50 minutes may be fixed as a time limit for convenience of administring the test. Each student must, however, complete the answers before they are collected for examination.

8. Total marks seemed by the students need not be intimated to them. Teacher will check the answers of each pupil against the scoring key, and mark out the wrong answers.

9. The teacher, then, will find out the weak points of each student by placing the wrong answers against the Item Content Chart. Two wrong answers against any learning point will indicate that the student has not learnt that point.

10. After locating the weak point, the teacher can take any remedial measure that he thinks fit to give further teaching on the weak point.

11. If one or two learning points appear to be the common weakness spots in several children, it may be necessary for the teacher to adopt a new technique in teaching the point to all the students. Otherwise the teacher can confine his remedial measures to individual pupils in specific learning points.

12. A list of suggested remedial measures for every teaching point is appended here to for guidance of the teacher.

DIAGNOSTIC TEST

QUESTIONS	ANSWERS
1. What are the three main parts of the maize grain?	1. (a)...................... (b) .... (c) ....
2. Name the part of the maize grain which covers the seed.	2. ....
3. What parts do the outer covering of the seed include?	3. (a).................... (b) ....
4. What are the three parts of the maize embryo?	4. (a).................... (b).................... (c)....................
5. Is the endosperm a part of the maize embryo?	5. ....
6. What three parts of the future plant are represented in the maize embryo?	6. (a).................... (b).................... (c)....................
7. Which part of the embryo of a maize seed contains the future shoot of the maize plant ?	7.. ....
8. What is the name of the embryonic shoot in a maize seed ?	8. ....
9. What part of the future plant arises from the apical part of the embryo ?	9. ....
10. What is the name of the outermost cover of the plumule in a maize seed ?	10. ....
11. In the maize seed there is a protective sheath over the embryonic shoot. What is its name ?	11. ....
12. In a maize seed, the seed coat protects the embryo from external damage. What structure gives additional protection to the plumule ?	12. ....

Contd.....4/-

QUESTION	ANSWER
13. The future shoot of a maize plant is seen in the embryo? What other part of the future plant is also seen in the embryo?	13. ....
14. Is it correct to say" the shoot of the maize plant arises from the radicle of the embryo?	14. ....
15. Is it correct to say"the roots of the maize plant arise from the plumule"?	15. ....
16. Coleorhiza is a structure found in the maize seed. Over which part of the embryo is it found ?	16. ....
17. Is the coleorhiza a part of the embryo?	17. ....
18. Does any part of the seedling grow from the coleorhiza?	18. ....
19. What is the shape of cotyledon of maize seed?	19. ....
20. What is the number of cotyledons in maize seed.?	20. ....
21. What is the name of shield shaped structure in maize seed ?	21. ....
22. What part of the embryo touches the endosperm in maize seed ?	22. ....
23. In the maize seed does the embryo lie embedded within the endosperm?	23. ....
24. Which layer of cotyledon cells lies towards the endosperm?	24. ....
25. Is food stored in the cotyledon in maize seed ?	25. ....
26. From which part of the seed does the embryo of a maize seed derive its food during gemination ?	26. ....

Contd...5/-

	QUESTION	ANSWER
27.	Is endosprm a part of the embryo ?	27. ....
28.	Which two of the following substances are chiefly found in the inner regions of the endosperm? (a) Starch, (b) fats, (c) proteins.	28. (a)...................... (b)......................
29.	What reserved material is contained in the Aleuron layer of a maize seed ?	29. ....
30.	What part of the scutellum secrets digestive enzymes in the maize seed ?	30. ....
31.	Can you see 'testa' in the maize seed ?	31. ....
32.	What two parts go to form the seed-coat in the maize seed ?	32.(a)...................... (b) ....
33.	What part of a fruit do you find in maize ?	33. ....
34.	"The maize grain is a fruit" is this statement correct?	34. ....
35.	Which part of a fruit in maize grain makes it different from an ordinary seed ?	35. ....
36.	Is maize grain a dry fruit or a seed ?	36. ....

:SCORING KEY:

QUESTION NO.	ANSWER
1.	(a) Embryo, (b) Endosperm (c) Seed Coat.
2.	Seed Coat
3.	(a) Embryo, (b) Endosperm
4.	(a) Radicle, (b) Plumule (c) Cotyledon
5.	No
6.	(a) Root. (b) Stem (c) leaf.
7.	Plumule.
8.	Plumule.
9.	Shoot
10.	Coleopitile
11.	Coleopitile
12.	Coleopitile
13.	Roots
14.	No
15.	No
16.	Radicle
17.	Yes
18.	No.
19.	Shield Shaped.
20.	One
21.	Scutellum
22.	Seutellum
23.	No
24.	Epithelium
25.	No
26.	Endosperm
27.	No
28.	(a) Starch, (b) Fats
29.	Protein
30.	Epithelium
31.	No
32.	(a) Pericarp, (b) Testa
33.	Pericarp
34.	Yes
35.	Pericarp.
36.	Dry Fruit.

ITEM CONTENT CHART:

S.NO.	TEACHING-LEARNING POINTS	QUESTION NO.
1.	Maize grain consists of three parts; the Embryo, the Endosperm and the seed-coat.	1, 2, 3.
2.	The embryo consists of Radicle, Plumule and Cotyledon	4, 5, 6.
3.	The plumule represents the future shoot	7, 8, 9.
4.	The plumule is protected by the Coleoptile.	10,11, 12.
5.	The radicle represents the future root system	13,14,15.
6.	The radicle is covered by the Coleorhiza	16,17,18.
7.	In the embryo there is a single shield-shaped cotyledon called Scutellum.	19,20,21.
8.	The embryo lies to one side of the Endosperm and is in touch with the latter by the Scutellum	22,23,24.
9.	The endosperm is the stored food for the embryo but it is not a part of the embryo.	25,26,27
10.	Stored food in endosperm is absorbed by the cotyledon. The epithelium secrets enzymes to digest the food.	28,29,30
11.	The seed coat is formed by the fusion of the pericarp of the fruit and the seed coat.	31,32,33
12.	The maize grain is a dry fruit not a seed.	34,35,36.

REMEDIAL MEASURES

S.No.	Learning point	Suggest remedial measure
1.	Wheat grain consists of three parts	Guide the students in making a longitudiual section of the grain, and in finding out the 3 parts of the seed. For clearly demarcating the embryo, a few drops of iodine solution may be put on the section for a while and then wahsed away in water. The embryo will stand out pale against the deep blue of the endosperm.
2.	Embryo consists of redicle plumule and cotyledon.	Guide the student in finding out the three parts of the embryo in the section with the help of a magnifying glass. The student should compare the structure in the section with a wall chart.
3.	Plumule represents the shoot	The student is asked to draw an enlarged diagram of the embryo faithfully from the section. The teacher explains the structures of the plumule and compares it with the shoot. The student find points of similarity between shoot and the plumule.
4.	Plumule is protected by the coleoptile.	Show the coleoptile in the section. Ask the students to describe its position and shape, and observe its similarity to other leaflets. The function of the coleoptile is explained.
5.	Radicle represents the root system	Same as in 3, refering only to the radicle and the root system of a seedling in place of the shoot system and plumule.
6.	Coleorhiza covers the radicle	Show the coleorhiza in the section. Guide the students in determining the structure and function.
7.	The cotyledon is called-Scutellum in maize grain	Guide the students to find the scutellum and compare the seutellum in the section with a wall chart. Show the intimate contact between the scutellum and the endosperm.

8. Relative position of Embryo and endosperm.	Ask the students to describe the relative position and then draw a diagram from memory.
9. Endosperm is the store house of food	Ask student to point out the endosperm. Ask students as to why this portion turns blue when treated with iodine. Explain the significance.
10. Food absorbed by the Scutellum.	Ask students as to why the embryo does not turn blue (or turns only pale blue) when treated with iodine. Let student show and name the part of the embryo that touches the endosperm. Explain significance of the opposition of scutellum to endosperm.
11. Seed coat formed by fusion of pericarp and testa.	Demonstrate pericarp and testa is a simple fruit like pod of pea. Demonstrate a maize 'ear' and explain that it consists of a large number of fruits. Bring out the difference between a pea fruit and the maize fruit by successively removing the coats in the two, to explore the cotyledons and embryo. Explain that the pericarp has fused with the seed coat to give only one covering over the seed of the maize fruit. Point out that maize fruit contains only one seed. It can also be compared with a green mango.
12. The maize grain is a dry fruit not a seed.	Explain the terms seed, fruit and grain. Point out that all grains are single seeded fruits. Give examples for students to identify seeds from grain and fruit.

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